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The East-west Oscillation of the Icelandic Minimum as shewn by Monthly Pressure Charts

By C. E. P. BROOKS, M.Sc.

CHARTS of the normal pressure distribution during any month or for the year show a well-marked minimum in the neighbourhood of Iceland and a maximum south of the Azores. Examination of a series of average charts for separate months shows, however, that both these "action centres" are subject to considerable variations of position from time to time; the Icelandic minimum shows the greatest variation in this respect. Since the position of the Icelandic minimum in any month is of great importance as an indication of the frequency and paths of depressions during that month, its movements have been the subject of several investigations,* especially by W. Meinardus and J. Petersen, who have developed the hypothesis that the position of the minimum is controlled by a "self-regulating mechanism," which in its simplest form may be described as follows. If in any month the Icelandic minimum lies westward of its normal position, say over Davis Strait, the isobars will have a more north-easterly trend than usual and the south-west winds between Iceland and north-west Europe

* MEINARDUS, W. Der Zusammenhang des Winterklimas im Mittel- und Nordwesteuropa mit dem Golfstrom. *Zs. Ges. Erdkunde, Berlin*, 1898, *p.* 195.

PETERSEN, J. Unperiodische Temperaturschwankungen im Golfstrom und deren Beziehung zu der Luftdruckverteilung. *Ann. Hydrogr., Berlin*, 38, 1910, *p.* 397.

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• For Indian stations a rain day is a day on which 0·1 in. (2·5 mm.) or more rain has fallen.

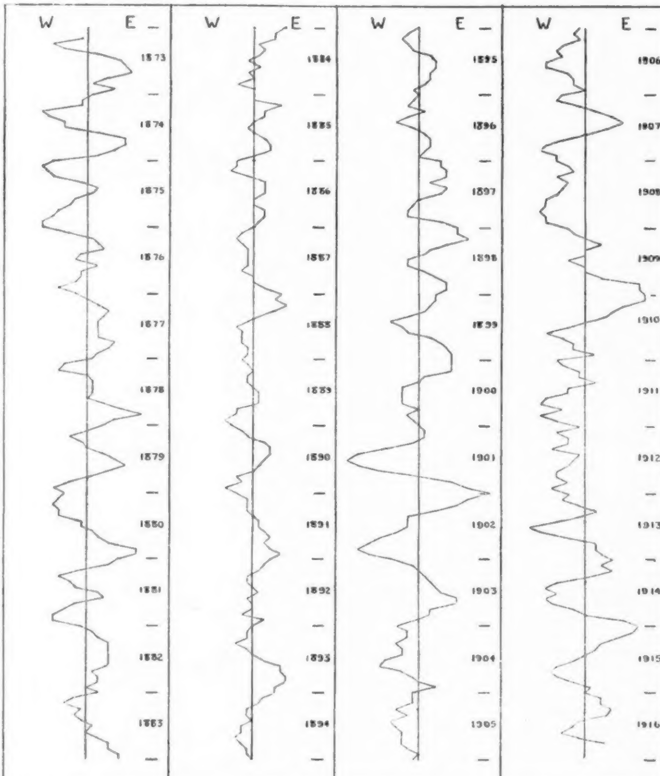
will be frequent and steady. These winds besides being themselves warm, will tend to accelerate the Gulf Drift and will consequently raise the temperature of the surface waters of the north-eastern part of the North Atlantic. This warm water will, after a time, warm the air above it and lower the pressure, drawing the Icelandic minimum eastwards and also causing it to become deeper. This process will still further increase the velocity and temperature of the Gulf Drift, but it will also cause northerly winds to the west of the minimum. These northerly winds will accelerate the cold Labrador current, and after a time will bring large quantities of ice and cold water into the North Atlantic off Newfoundland. These, finding their way into the Gulf Drift, will cool its surface waters somewhat. Carried along by the drift, the cold water will eventually reach the north-eastern Atlantic. Pressure in that region will rise again and the Icelandic minimum will be driven westwards to Davis Strait, when the process will recommence.

The easiest way to test the reality of this cycle is by a study of pressure charts, and the results of such a test are described below. First, however, we must have some estimate of the time required for the cycle to complete itself. This can best be found by considering the velocities of the various ocean currents involved. With the Icelandic minimum over Davis Strait the warming up process in the north-eastern Atlantic will begin almost immediately, and we may assume that it reaches its maximum when the water, initially off the Newfoundland Banks, reaches the Shetland Islands. The distance is about 1,800 nautical miles and the average speed is about 12 miles a day, so that the process normally takes about 150 days or five months. Before the process is completed the Labrador current will already be strengthened, and, as it normally takes less than three months for this current to travel from 69° N to 53° N, it seems probable that with an accelerated speed the influx of cold water and ice into the North Atlantic will commence soon after the time when the Icelandic minimum reaches its most easterly position. The cold water takes about 150 days to reach the north of Scotland and complete the cycle. Thus we find by calculation an average period of ten or eleven months to be required for the changes involved, but, since the wind-driven ocean currents are subject to great variations from time to time, the period may be much shorter or longer in individual cycles.

Since the cycle sought is of the order of a year, and there is already an annual variation in the position of the Icelandic minimum due to seasonal causes, the latter must be eliminated. This is done by employing charts of differences from normal instead of actual pressure values. The most convenient unit

is the month. Monthly charts of deviation of pressure from normal over the northern hemisphere for the years 1873 to 1900 have recently been drawn at the Meteorological Office, mainly

FIG. I.



East-West Oscillations of the Icelandic Pressure Minimum.

from the data in the two collections* by Wl. Gorczynski and the U.S. Weather Bureau, and charts for the whole globe for the

* GORCZYNSKI, WL. Pression atmosphérique en Pologne et en Europe. *Warszawa*, 1910.

WASHINGTON U.S. DEPT. AGRIC., WEATHER BUREAU. Report on the barometry of the United States, Canada and the West Indies. *Report* 1900-01, *pt.* 2. *Washington*, 1902.

years 1910 to 1916 have been drawn in connection with the *Réseau Mondial*. Monthly charts of the Icelandic region for the years 1901 to 1909 were specially drawn, thus making a series of 44 years, or 528 monthly maps, available for the study. These charts were examined and a number ranging from — 4 to + 4 was assigned to each according to the position and intensity of the Icelandic minimum, — 4 indicating that the minimum was well developed and lay over Davis Strait and + 4 that it was well developed and lay off the coast of Europe. Where the minimum was divided, or there was no evidence of displacement, 0 was entered: in less neutral cases intermediate values were assigned. When these figures were plotted there were some indications of the movement sought, but they were largely masked by irregular fluctuations from month to month. It was evident that the month was too short a unit, so the figures were formed into overlapping sums of four months, giving a scale of — 16 to + 16, and an east-west motion at once became apparent over a large part of the period (Fig. 1). Thus it seems probable that the theoretical cyclical variation in the position of the Icelandic minimum occurs to some extent. In the whole period there are 43 complete oscillations with an average length of 12.1 months, but the individual length varied from 5 to 21 months. Measuring the intervals between successive easterly maxima and successive westerly maxima separately we have 86 values distributed as follows:

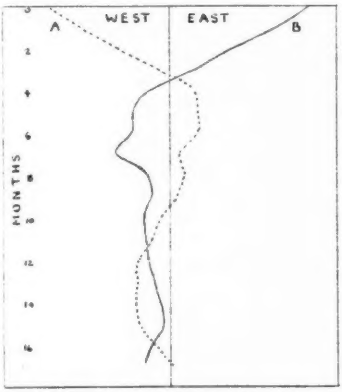
Length in months	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Frequency	3	3	1	7	8	8	11	13	7	3	5	4	6	1	2	2	2

There is a well-marked crest at 11 to 12 months and a lesser crest at 15 to 17 months, but the minimum at 14 months may be accidental.

The persistence of an interval of twelve months after the elimination of the annual variation is rather curious. Over the whole period the average values of the individual months in no case exceed 1 on the scale of — 16 to + 16, but when shorter intervals are considered there is a tendency for easterly or westerly maxima to recur at the same season in successive years. Thus from 1873 to 1883 the chief easterly maxima fall mainly between August and December and the westerly maxima between January and April: the same applies to the years 1889 to 1896, though in this period the cycle was much less pronounced. On the other hand the easterly maxima generally occurred in the early

months and the westerly maxima in the later months from 1884 to 1888, 1897 to 1902 and 1910 to 1916. Thus there seems to be a more or less regular recurrence of the same phase of the cycle at about the same times in successive years, alternating with occasional almost complete reversals, and it is suggested that this is due to some form of seasonal control, probably to the fact that the Icelandic minimum is poorly developed from May to August and consequently extremes of its easterly or westerly development are least frequent in these months. On the other hand, there is probably no real periodicity underlying the whole series. On the whole, in the first half of the series (up to 1895) the westerly maxima occur in the early months and the easterly maxima in the later months, while in the second half this distribution is reversed. When the Icelandic minimum lies near the European coast we should expect heavier rainfall in the British Isles than when it lies west of Greenland, and this is borne out by the rainfall data :

FIG II.



Average position of Icelandic minimum following maximum displacements to the West (A) and East (B).

Years	1881–85	1886–90	1891–95	1896–1900	1901–05	1906–10	1911–15
Per cent. of normal.							
Jan. to Mar. ...	105	89	86	100	105	100	113
July to Sept. ...	107	101	110	97	103	92	89
Difference ...	−2	−12	−24	+3	+2	+8	+24

A potent cause of variations in the length of the cycle must be variations in the pressure gradient between the Azores anticyclone and the Icelandic minimum. When this gradient is weakened, the Gulf Stream Drift must also be weakened, and the cycle will take longer ; when the gradient is strengthened the cycle will complete itself in a shorter interval. Examination of the charts shows that this tends to be the case. If we super-

pose a number of cycles in order to produce a composite curve, the variation in length spoils the result. In Fig. 2 are shown the variations during the period of 17 months following the 17 chief westerly maxima and the 15 chief easterly maxima. Curve A passes from a maximum westerly position to a maximum easterly position in six months, and returns to a new westerly maximum in 13 to 14 months. Curve B passes from a maximum easterly position to a maximum westerly position in seven months, but fails to show the succeeding easterly maximum.

The results of the investigation seem to confirm the existence of Meinardus and Petersen's self-regulating mechanism and to assign an average period of about twelve months for its operation, but the latter period is so variable that the cycle is useless for forecasting until the causes of the variations have been worked out. At the same time it offers a line of investigation which may produce very useful results for the study of slow changes in the distribution of pressure.

Variability of Tropical Climates—III.

By STEPHEN S. VISHER, Ph.D. (Chicago).

Storm Irregularity.

ANOTHER climatic factor subject to marked changes is storminess. Cyclonic storms are erratic in all parts of the world, but the extremes appear to be greatest in low latitudes. The range in the number of hurricanes damaging Australia, for example, has been from one hurricane in 1907 and 1919 to seven in 1916 and eleven in 1912. In the South Indian Ocean the variation reported by the Mauritius Observatory has been from one storm in 1900 to eight in 1894 (and several other years) and to thirteen in 1913. In the Philippines in a 15-year period the number of very severe typhoons varied from one in 1916 to seven each in 1908 and 1911. In respect to less violent cyclonic storms there appears to be a somewhat similar range. For example, the total number of well-marked tropical cyclones occurring in Queensland, Australia, varied from eight in 1920 to twenty-four in 1916. In respect to the month of occurrence as well as in annual frequency there likewise is marked irregularity. In some years cyclones may be lacking during the months when they normally are most frequent, and occur only in months supposed to be free from dangerous storms. Of thunderstorms also there is marked variation, perhaps more than in higher latitudes. Many stations in Fiji and elsewhere have experienced several times as many in

one year as in another. While many hurricanes are accompanied by appalling lightning, other equally severe hurricanes have none.

Variations in Barometric Pressure.

One of the tropical variations which has aroused considerable scientific interest is the persistent double daily change in air pressure, the maxima occurring about 10h. and 22h. and the minima about 4h. and 16h. These minor curves are often evident on barograph records of even the most violent hurricanes with their great fall in pressure, sometimes nearly 2 in. within a few hours. Hence the general absence or imperceptibility of double diurnal waves in higher latitudes can scarcely be ascribed solely to the interference of cyclonic storms there. Seasonal changes in average pressure, while not so great as in certain parts of high latitudes, are commonly as much as 0·5 in. in the tropics.

Changes of the Weather.

Slight changes of weather are almost constantly taking place in the tropics. A rainy spell will be succeeded by a less rainy one or by a few rainless days ; a hot spell by a slightly cooler one ; a spell of fitful breezes by several days of steady winds. Such changes have been noticed by the writer in Jamaica, Hawaii, the Philippines, the East Indies, Queensland and elsewhere, but have been especially studied in Fiji. There, a study of the official records taken at Suva reveals an average of about 20 distinct spells of weather well distributed throughout the year, with about as many less distinct changes.

Conclusion.

In conclusion, when all these types of variation occur, is it desirable to spread the impression that tropical climates are extremely uniform ? But although tropical climates are not so uniform as has been believed, it does not follow that they are better adapted to civilized man than has been supposed. Most of the variability within the tropics is of a highly irregular sort compared with the variability characteristic of the parts of higher latitudes where civilized man mostly lives. Indeed, it appears that tropical climates are unfavourable for a high type of civilization, not alone because of the high temperatures and the general lack of stimulating seasonal changes in temperatures, but also because of the often extreme undependability of the rainfall, the occurrence not infrequently of destructive windstorms and other unfavourable variations. But, nevertheless, highly civilized man can cope with the numerous problems of the tropics far better than can primiti.e peoples. Indeed, the latter, unaided, have made little progress. Hence, fuller utilization of the tropical resources awaits a greater participation by civilized man.

OFFICIAL NOTICES

Lectures at the School of Meteorology 1923-1924

THE following courses of lectures have been arranged in connection with the School of Meteorology of the Imperial College of Science and Technology, for the session 1923-24.

1. *Introductory General Course.* A course of lectures by Sir Napier Shaw, F.R.S., on Fridays at 3 p.m., during the first half session, on the Normal Circulation of the Atmosphere and its Variations, seasonal and temporary.

2. *Discussions of the Incidents of the Weather Reports of the previous week* by Sir Napier Shaw, F.R.S., on Tuesdays at 10.15 during term time.

3. *Short Courses on Technical Subjects.*

(A) *Meteorological Optics:* a course of five lectures during the spring term, by Mr. F. J. W. Whipple.

(B) *Radiation:* a course of five lectures during the summer term, by Sir Napier Shaw, F.R.S.

4. *Advanced Meteorology, Dynamical and Physical.* A course of twenty lectures on Mondays at 3.30 during the winter and spring terms by Captain D. Brunt.

Further particulars may be obtained on application to the Secretary, Imperial College of Science and Technology, South Kensington, S.W. 7.

Discussions at the Meteorological Office

THE meetings for the discussion of recent contributions to meteorological literature, especially in foreign and colonial journals, will be resumed at the Meteorological Office during the session 1923-24. The meetings will be held on alternate Mondays at 5 p.m., beginning on Monday, October 15th, 1923, when Sir Napier Shaw, F.R.S., will open the discussion of a paper by V. H. Ryd on "Travelling Cyclones," *Publikationer fra Det Danske Meteorologiske Institut Meddelelser.* Nr. 5, 1923.

The dates for subsequent meetings are as follows:—

October 29th; November 12th and 26th; December 10th, 1923; January 21st; February 4th and 18th; March 3rd, 17th and 31st, 1924.

A Course of Training for Observers

A SECOND course of training for Meteorological Observers will be held at Kew Observatory in April or May, 1924. It is proposed to make this course an annual function. Particulars will be issued later.

International Cloud Week

On account of the International Conference of Directors of Meteorological Institutes and Observatories to be held at Utrecht at the beginning of September, the date of the International Cloud Week* has been changed from September 17th-23rd to September 24th-October 1st, 1923. Further particulars may be obtained from Capt. C. J. P. Cave, Stoner Hill, Petersfield, Hants, or Mr. G. A. Clarke, University Observatory, Aberdeen.

Official Publications

The following publications have recently been issued :—

Geophysical Memoirs—

No. 20. *Variations in the Levels of the Central African Lakes Victoria and Albert.* By C. E. P. Brooks, M.Sc. (M.O. 220j.)

No. 21. *Pyrheliometer Comparisons at Kew Observatory, Richmond, and their bearing on data published in the Geophysical Journal.* By R. E. Watson, B.Sc. (M.O. 254a.)

Professional Notes—

No. 33. *Diurnal and Seasonal Variations of Fog at certain Stations in England.* By F. Entwistle, B.Sc. (M.O.245m.)

Book of Normals of Meteorological Elements for the British Isles for periods ending 1915. *Section* IV.

(*a*) Range of Variations of Temperature and Rainfall.

(*b*) Frequency Tables for Hail, Thunder, Snow, Snow lying and Ground Frost. (M.O. 236.)

The issue of special geophysical supplements to the *Monthly Notices* of the Royal Astronomical Society was inaugurated in March, 1922. Up to the present, three numbers have appeared, containing papers on Seismology (6), Wireless Time Signals (2), The Electric Stability of the Earth, Map Projections, Terrestrial Magnetism and The Variation of Latitude (one each). Non-Fellows of the Society may obtain the Supplements by applying to the Assistant Secretary, Royal Astronomical Society, Burlington House, London, W. 1, at a price just sufficient to cover the cost of publication ; the numbers already issued cost 7s. 6d. in all. A deposit of 10s. should accompany applications ; notice will be sent to subscribers when this deposit is exhausted.

* *Met. Mag.*, vol. 58, June, 1923, p. 111.

Correspondence

To the Editor, *The Meteorological Magazine*

A Brilliant Halo : June 30th

As the halo which I observed* on June 30th is apparently of an exceptional nature I should like to emphasize certain points.

There were no outer arcs of any kind about the upper quadrants. Those below started from near the horizontal, but "lop-sided," *i.e.* from a few degrees above on the right, as much below on the left. The colours were in the same order as the inner, normal, halo. The space may have been more than $1\frac{1}{2}°$, but I think not, and this was at 45° to horizontal. The effect reminded me of the "bulge" stuck on outside the hulls of ships for protection against torpedoes. It remained evident, though not quite continuously, until the upper clouds were obscured.

J. EDMUND CLARK.

41, *Downscourt Road, Purley, Surrey.* 18*th July*, 1923.

Thunderstorms in June, 1923

WITH reference to the footnote on page 149 of the August issue of this Magazine, a communication has now been received from the Radcliffe Observer, Oxford. He states that: "A sharp shower of rain fell at about 20h. 30m. on June 15th, and at the same time the observer noted a single peal only of thunder. There is no note of intensity, hence it is to be inferred that the thunder was neither heavy nor at all distant. No lightning was observed."

It will be recognised that the shower in question was probably of the line-squall type. This hypothesis is supported by the *Daily Weather Report.*

NOTES AND QUERIES

London's Water Supply

IN the *Seventeenth Annual Report* by Sir Alexander Houston, Director of Water Examination for the Metropolitan Water Board, is to be found an interesting popular account of the arrangements for the supply of water to London. To most readers the most novel part of the story is the description of the successful treatment of river water by chlorination.

Before 1916 it was customary to purify Thames water by pumping it into the great storage reservoir at Staines and leaving it there for a month. To save the cost of pumping, the experiment of adding chloride of lime to the water in the aqueduct

* *Met. Mag.*, vol. 58, July, 1923, p. 127.

and passing it almost directly to the filter beds was tried, and it was found that the water supply was actually more free from bacteria than hitherto. The reduction in the coal bill amounts to some £17,500 a year, whilst the cost of the chloride of lime is only £1,500. The principal use of the Staines reservoir now is to maintain the supply of pure water when the Thames is in flood.

Early Records of Notable Weather

MR. RICHARD COOKE, of Detling, near Maidstone, sends some weather notes of the 17th and 18th century. The following are from *Ashford, its Vicars, College and Grammar School*, by the Rev. A. J. Pearman [1888]:—

> 1673. *Samuel Warren, B.A., Vicar.*
>
> In Mr. Warren's handwriting we have some notes of the weather.
>
> "There fell a great deal of snow on April 22, being Good Friday, 1676 [*sic*]. Hills, meadows, houses all covered with snow: and on May Day following, and on the 4th of May fell much snow, that in some places there were drifts, it was above a yard deep and lay several days on the hills, which we could see several miles off, and all this time very cold weather and so continued about 10 days. It was very wet and cold to the 5th of June.
>
> "In the year 1683 there was a very hard frost, beginning a little before Christmas and lasted 7 weeks. The frost went three feet in the ground, froze all rivers that mills could not grind, the sea about Hithe and Dover was frozen many miles into the sea. The Thames at London so frozen that they built streets upon it, and coaches went commonly upon it. The like frost has not been known in man's memory.
>
> "On 28th July, 1703, being Wednesday, it began to rain between 6 and 7 in the morning and held till 2 o clock in the afternoon pretty moderately, and then it began to rain exceeding hard, with very little intermission, until between 4 and 5 the next morning, which caused a great flood that carried away a great deal of hay out of the meadows down the river: a great loss to many people.
>
> "On Friday and especially on Saturday morning the 26 and 27 days of November, 1703, there were most terrible and dreadful storms of wind with which it pleased Almighty God to afflict the greatest part of this Kingdom. Some of our ships of war and many other ships were destroyed and lost at sea and great numbers of men serving on board the same perished. And many houses barns and other buildings were either wholly thrown down and demolished, or very much damnified and defaced and thereby several persons killed, viz., the Bishop of Bath and Wells, Dr. Kidder, &c. And many stacks of corn and hay thrown down and scattered abroad, to the great damage and impoverishment of many others, especially the poorer sort. And great number of timber and other trees were torn up by the roots, others broke short asunder in the middle; some whole orchards rooted up, others much damnified. Philip Warham of Wye had 220 trees blown down in his orchard. A calamity of this sort, so dreadful and astonishing that the like has not been seen or felt in the memory of any person living in the nation. Hereupon the Queen [Anne] appointed a general fast throughout the Kingdom on Jan. 19 following."

L'Institut de Physique Cosmique de Moscou

THE Meteorological Office has recently received the first bulletin of "l'Institut de Physique Cosmique de Moscou," which now occupies the buildings formerly used by "L'Institut Aerodynamique de Koutchino." The latter institute was founded in 1904 on the initiative of Prof. D. P. Riabouchinsky. Aerodynamical and hydrodynamical experiments and investigations, including upper air observations by means of balloons and kites, were carried out and the results of the work published in occasional bulletins.

The programme which is now being carried out, covers, as the name of the Institute implies, a much wider field than that formerly covered by l'Institut Aerodynamique. With regard to meteorology the most interesting point to be noted among the statutes is that the Institute is to have "tous les locaux qui se trouvent dans la 1-re, 2-me et 3-me anciennes propriétés de Riabouchinsky, et aussi la zone défendue, 200 désiatines de dimensions, pour garder les conditions de climat invariables."

The Institute is under the authority of the Centre Académique du Commissariat de l'Instruction and is affiliated to the Observatoire Physique Central de Petrograd for all its meteorological work.

Rainfall Insurance

WE are glad to see that the form of rainfall insurance policies is under discussion in the United States. Most people in this country have heard of the possibility of insuring against their holidays being spoiled by rain ; it is not generally known however that policies for comparatively large sums of money are taken by the promoters of athletic meetings, flower shows and other fêtes which depend for their success on fine weather. It has become customary in such cases to insure against the occurrence of the tenth of an inch of rain between the hours 9 a.m. and 9 p.m. Incidentally it may be remarked that the policies are often very carelessly drawn up with no provision as to where the rain is to fall or as to who is to measure it. It is left open to doubt whether Summer Time or Greenwich Time is intended. As has been brought out by American experience the criterion is not a satisfactory one, the financial success of an athletic meeting is not affected by a heavy thunderstorm in the late afternoon, whereas light rain earlier in the day may prove ruinous.

Frequently people who might be expected to know better state that insurance is a form of gambling. Of course, sane insurance is the reverse of gambling. The man who fails to insure his house against the risk of fire is the gambler, the man

who insures it " hedges " so as to eliminate as far as possible the element of risk. The total value of his assets remains the same if a fire occurs or not. The accusation which can fairly be brought against the present system of insurance against rain is that it is gambling, not hedging. An example which came to our notice recently may be quoted :

The promoters of a large gathering took out a policy for £400, paying a premium of £60. Drizzle commenced about 12 o'clock on the day in question and continued for two hours ; the total fall in that time being about 0.05 inch. The attendance was so seriously affected that the gate money did not equal the prize fund. In the course of the afternoon there was a sharp shower and it was found subsequently that the total fall for the 24 hours 9 a.m. to 9 a.m., as measured in the nearest gauge, was 0.09 inch. It will be noticed that there was no effective insurance against the real cause of loss. Betting on whether the afternoon shower should pass half a mile to the north or to the south of the athletic ground was a mere gamble.

According to the scheme which has found support in America, there should be insurance against the occurrence of the hundredth of an inch of rain in any or each of certain hours. We commend this scheme to the notice of underwriters in this country, pointing out, however, that the installation of a special open scale recording raingauge at an agreed spot and under expert control would be necessary in each instance.

F. J. W. Whipple.

The History of the Fahrenheit Thermometer

Our works of reference usually explain that the scale of Fahrenheit's earlier thermometers was such that the zero was the temperature of the mixture—ice, water and sea-salt, whilst 24° was blood temperature, that Fahrenheit subsequently used the more open scale with 0° and 96° for these two temperatures, and that this is very nearly the scale to which his name is now given. From a recent article by Prof. E. Lagrange in *Ciel et Terre*,* or rather from a translation by Dr. C. F. Brooks in *Tycos*,† we learn that the researches of Mme. K. Meyer have shown that credit for the earlier of these scales should be given to the Danish physicist Öle Roemer, from whom Fahrenheit must have adopted it. The evidence seems satisfactory.

A word of caution may not be out of place : Roemer is not to be confused with Réaumur, whose name is given to the thermometer scale with the zero at the freezing point and 80° at the boiling point of water.

* Nov.-Dec. 1922, pp. 357-363.

† Vol. xiii. July, 1923, No. 3, p. 16.

Theories of the Anti-Solar Light

THE anti-solar light (*Gegenschein* or *Counterglow*) is a faintly luminous patch which can be observed at night under favourable conditions in the prolongation of the line joining the centres of sun and earth. In a note published in the May number of *Ciel et Terre* over the initials of M. Max Hauptmann, the theories of Gyldèn and Moreux, both depending on the existence of the neutral point at which the gravitational attractions of the sun and earth balance centrifugal force, are explained. The older theory, Gyldèn's, assumes that meteoric matter would be concentrated at the neutral point, whilst Moreux (*Scientifica et Revue du Ciel,* April, 1923) supposes that the atmospheric gases driven off by light pressure would be attracted in the same way. Hauptmann points out, however, that if light pressure is the moving cause there is no reason to suppose that there would be any concentration at a neutral point (the gas would be driven past that point), and he makes the suggestion that the diffuse stream of gas should itself be visible in the sunlight. In fact, the earth is a comet, and the observer of the anti-solar light is looking from the comet down its tail. This suggestion brings this phenomenon within the range of meteorology. The weak side of it is the neglect of the characteristic feature of comet's tails, their inclination to the radius from comet to sun.

We must confess, however, to a prejudice against this frittering away of the earth's atmosphere. Hauptmann does not refer to the theory that the earth's atmosphere acts like a lens giving a badly focussed image of the sun. This image is at no great distance from the earth, and it is not impossible that there may be sufficient matter at that distance to act as the screen on which the image is projected and made visible.

Thermometer Exposure

FROM time to time attention has been called to the difficulty introduced into comparisons of air temperatures by the effect of exposure upon the values recorded. There is no international agreement as to the standard form of exposure. In the United States the temperatures utilised for the daily weather service are mostly recorded at stations on high roofs in the centres of the larger towns.* In this country the general rule is to utilise only the observations of thermometers exposed in Stevenson screens in open sites and 4 ft. above ground. In India the thermometers have been set up hitherto in open sheds of a special design, but a thorough investigation by Dr. Field has led to the adoption of the Stevenson screen as the standard of that country.

No doubt the practice in other tropical countries where the Indian shelter is in use will be brought into line.

An anomaly in our own organization has been the use of the North Wall screens at certain observatories either instead of or in addition to the Stevenson screen. The North Wall screen offers the advantage that it is convenient for the installation of autographic instruments but it is well known that it gives a smaller daily range of temperature than the Stevenson screen. At Kew Observatory a series of comparisons have been made during recent months between the readings of thermometers in the North Wall screen, in a Stevenson screen on the lawn and on a Glaisher stand (this stand being the one formerly in use at Camden Square, the old headquarters of the British Rainfall Organization). It was found that the study of the differences between the temperatures recorded in the screens on the lawn and on the north wall was complicated by the fact that the difference in height had to be allowed for as well as the difference in exposure. To obviate this difficulty, a Stevenson screen has been set up on a wooden structure so that the thermometer bulbs in this screen are 17 ft. above the grass plot and level with the bulbs of the thermometers in the North Wall screen. The new high screen came into use in the middle of February.

An indication of the types of result that are being obtained may be given. The following figures all refer to the month of May, 1923:—

Maximum Temperature for the interval 7h.—18h., G.M.T.

Mean Excess: Glaisher stand, compared with normal Stevenson screen ... ... 2·0°F.

Mean Excess: Normal Stevenson screen compared with Stevenson screen at 17 ft. ... ... 1·3°F.

Mean Excess: North Wall screen compared with Stevenson screen at 17 ft. ... ... 0·5°F.

Maximum Temperature for the interval 18h.—7h., G.M.T.

Mean Excess: North Wall screen compared with either Stevenson screen or with the Glaisher stand 2·0°F.

It is remarkable that in the short May nights there was no appreciable difference between the minima at 17 ft. and at 4 ft. so that all the lawn exposures can be grouped together.

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*In the U.S. *Monthly Weather Review*, April, 1923, p. 190, Meisinger discusses the merits of temperature observations at aerodromes (*e.g.*, Groesbeck, Tex., thermometers 11 ft. above ground) and at normal Weather Bureau stations (*e.g.*, Palestine, Tex., thermometers 64 ft. above ground) in estimating the temperature aloft with a view to the construction of pressure maps for such heights as 1 km. and 2 km. above sea level. He decides (*l.c.*, p. 197) in favour of eliminating the aerological stations from the network and using only regular Weather Bureau stations.

The Cruickshank Lectureship in Astronomy and Meteorology

THE University of Aberdeen intends in the autumn of this year to inaugurate the Lectureship in Astronomy and Meteorology which has been contemplated for some time past, and for which two funds have been accumulating for many years. One of the funds originated under the Will of the late Miss Anne Hamilton Cruickshank, daughter of the late Dr. John Cruickshank, who was appointed Professor of Mathematics in the Marischal College and University, Aberdeen, in June, 1807, and held office until the union of Marischal and King's Colleges in 1860. By a trust disposition, dated 1898, Miss Cruickshank directed her Trustees to apply a portion of her money for the endowment of a Lectureship in Astronomy, including Navigation and Meteorology, in the University, on account of the great interest her father had taken in these three subjects, and the increasing need for instruction in them.

The other fund came from the University Observatory Fund, which originated from an unexpended balance of the sum of £800 paid in the end of the 18th century by the War Office to the University of Aberdeen by way of compensation for the old Astronomical Observatory on the Castle Hill of Aberdeen.

The lecturer will be expected to devote himself to research in Astronomy and Meteorology, and will be required to deliver only a limited number of lectures. All names of applicants should be lodged with the Secretary to the University of Aberdeen before November 1st, 1923, from whom all particulars may be obtained.

International Congress of Navigation

THE 13th International Congress of Navigation met in London in July, 1923. A paper which had been prepared by the late M. de C. S. Salter was discussed on July 5th by a sectional meeting devoted to the consideration of the relation of water supply to inland navigation.

Mr. Salter's paper, *The Volumetric Determination of Rainfall*, is illustrated by a set of maps showing rainfall over the catchment area of the River Don. These maps represent the rainfall on particular days, days with thunderstorm rain, cyclonic rain and orographical rain respectively. Another map represents the average annual rainfall. The likeness of this map to that showing orographical rain is striking, and supports the generalization that thunderstorm rain and cyclonic rain are of comparatively little importance in the hilly parts of the British Isles.

A paper by Mr. H. A. Reed, Chief Engineer Manchester Ship Canal Co.—*Some Notes on the relation between Rainfall and the*

Discharge of the River Mersey in the year 1921—may also be mentioned. The discharge of the Upper Mersey, which drains an area where there is much industrial use of water, amounted to 55 per cent. of the rainfall. The stabilising effect of the use of reservoirs for various purposes is noted.

Autographic Record of Soil Temperature at Kew Observatory

WITH a view to obtaining continuous records of underground temperatures at given depths a new type of distance thermograph, designed by Messrs. Negretti and Zambra, has been installed recently at Kew Observatory. The thermograph has two pens, actuated by "mercury in steel" thermometers, the bulbs of which are connected to the recording mechanism by means of flexible capillary tubes about 10 feet in length. The capillary tubing is made of a special kind of steel which has no affinity for mercury, and rusting on the outside is prevented by means of a coating of lead. The bulbs are buried in the ground at depths of 4 and 12 inches.

In addition to the recording thermometer, four "mercury in glass" thermometers have been installed in close proximity to it. The stems of these thermometers are bent at right angles so that the upper portion lies horizontally on the ground. The bulbs are placed at depths of 4, 6, 8 and 12 inches; the readings at 4 and 8 inches are of importance in connection with the crop weather scheme of the Ministry of Agriculture and Fisheries.

Review

A DICTIONARY OF APPLIED PHYSICS. Edited by Sir Richard Glazebrook, K.C.B., D.Sc., F.R.S. Vol. V. *Aeronautics-Metallurgy-General Index.* 8vo., 9×6, pp. vii.+592. *Illus.* Macmillan and Co. 1923. £3 3*s. net.*

The professional work of meteorologists tends to bring them into close touch with the practical side of aeronautics, the actual conditions under which flight is being carried on. A nodding acquaintance with the more theoretical side is desirable however. Such an acquaintance and a good deal more can be achieved by the study of the latest (and last) volume of the *Dictionary of Physics.*

As to matters with which we are directly concerned, we notice that there is still considerable doubt as to the conventions to be adopted in the graduation of altimeters and as to the allowances to be made for temperature and pressure in judging the performance of engines and aircraft. Pressure and temperature are mainly effective in aerodynamics in so far as they determine together the density of the air. The resistance which has to be

overcome as an aeroplane moves through the air at a particular speed is proportional to density and to a first approximation at any rate so is the amount of air which is sucked in through the induction-pipe of the engine. For this reason, as Prof. Bairstow states in the article on Performances of Aircraft, "it has been usual in the reduction of British performance results to assume that the horse-power of an engine is a function of density only. This approximation was justifiable in view of the state of knowledge existing in 1918, and, although there is now evidence to show that a distinct temperature effect exists, it is also clear that the changes introduced by the new knowledge are of a secondary order. The calculations which convert an observed performance into performance in a standard atmosphere are greatly simplified by the neglect of a temperature effect, for both the aerodynamics and engine power then depend only on the single atmospheric characteristic, density. The observed speed and rate of climb need only be ascribed to a height in the standard atmosphere where the density is that recorded in observation, for the necessary reduction to be made."

Reference to the article on the Effect of Altitude on the Running and Performance of Engines for Aircraft, by G. H. Norman, reminds us, however, that there are reasons why the horse-power should depend on atmospheric pressure rather than on density. The induction-pipe of the engine is generally heated in one way or another so that its temperature does not depend at all closely on that of the atmosphere. If the temperature of the induction-pipe is strictly constant, the weight of air taken in by the engine at each stroke will be proportional to pressure. Some experiments have been consistent with this dictum, but the most reliable results suggest a compromise, the power generated is proportional to $pt^{-\cdot 4}$, p being the pressure and t the absolute temperature of the air. It is worth noting that the fact that an aeroplane engine develops the greatest power when it is nearest to the ground is a positive advantage.

Another question in which meteorologists may be interested is the effect of sunlight on textile materials* such as the wings of aircraft. "Varnished doped fabric proved, however, to be no better than the unvarnished in respect of permanence of strength on exposure to sunlight. Ramsbottom showed that by the introducton of very finely-ground opaque pigments into the varnish the deterioration of the fabric by sunlight could be effectively avoided. The pigments were at first introduced in order to render machines less visible from above, but the advantages to be obtained in this direction were found to be far exceeded by the gain in permanence: for example, a doped fabric which lost 49 per cent. of its strength in 28 weeks, lost, when suitably

*See Article on *Doping of Aeroplane Wings*, by Guy Barr, p. 45.

protected, only 4 per cent. over the same period. The pigment finally selected was of a dark khaki colour, made by mixing yellow ochre, Prussian blue, and carbon black." In such bright sunshine as occurs in Egypt the absorption of solar radiation by dark-coloured varnishes had disadvantages, however, and it was found necessary to superimpose a coating of varnish containing aluminium powder.

From the short article by Wing-Commander T. R. Cave-Browne-Cave on the protection of airships and kite balloons from atmospheric electricity, we learn that during the war kite balloons were frequently struck. "Observation showed that in the case of many balloons destruction was due to a discharge which was either induced by a lightning stroke in the neighbourhood or more frequently was associated with no visible flash at all. Destruction by a direct flash to the balloon itself was very rare." The remedy adopted was to fit "discharger bands" with sharp discharger points with good metallic connections leading down to the wire rigging. On the other hand the danger to an airship is said to be small. "A rigid airship secured by the bow to a steel mast rode out a lightning storm of quite exceptional intensity with vivid flashes of lightning quite close to the ship. A non-rigid airship flying on the outskirts of the same storm was destroyed by fire in circumstances which were not of course explained, but were very possibly of electric origin."

The division of the subject matter of this last volume of the *Dictionary of Physics* into two Parts (devoted to Aeronautics and Metallurgy respectively) is an improvement. It is also to be noted that a General Index to the whole Dictionary is printed at the end of this volume.

F.J.W.W.

News in Brief

The London County Council's programme of lectures and classes for teachers for 1923-24 includes a course of six lectures on *British Weather* to be delivered by Sir Napier Shaw.

A daylight saving bill has recently been passed in Montevideo. It states that "The legal time throughout the Republic is the mean meridian time of the National Institute of Meteorology of Montevideo, put forward forty-four minutes fifty-one seconds from the 30th September to the 31st March, and fourteen minutes fifty-one seconds during the remainder of the year."

According to *The Times*, Professor Helland Hansen, the Norwegian scientist, has left Bergen with an expedition aboard the Bergen Museum vessel, the *Armauer Hansen*, on an oceanographic investigation about 124 miles from Aalesund, where it is intended to measure the speed of the Gulf Stream at various depths.

A new feature was introduced in the monthly "flysheet" (*Supplement to the Daily Weather Report*) with the issue for July, 1923. For three stations—Stornoway, Valencia Observatory and Kew Observatory—means of pressure and temperature with differences from normal are given, and also wind-roses. The table of surface visibility, an equivalent of which has been incorporated in Table IV. of the *Monthly Weather Report* since the beginning of the year, is now omitted from the flysheet.

Capt. Roald Amundsen states that he will try again next year to fly across the Pole from Spitzbergen.

The Weather of August, 1923

FINE sunny weather marked the first day of the month, but on the second and third a deep depression passed across Ireland and Scotland, causing heavy rain in these countries, with high winds generally over the British Isles and gales in Ireland and Wales—gusts of between 60 and 70 miles per hour were recorded at several stations, *e.g.*, Holyhead, Quilty and Cahirciveen. After the passage of this disturbance further depressions from the Atlantic took a more northerly course, maintaining unsettled conditions only in the west and north, while in the south-east the weather became fine and warm as the anticyclone centred over France spread northwards. These conditions lasted nearly a fortnight. During this period 80° F. was exceeded on several occasions in the south-east, and also 90° F. in parts of London on the 9th. At the same time the sunshine records were large, *e.g.*, Margate had 83 per cent. of the possible duration of sunshine during the week August 5th to 11th, and Worthing 79 per cent.

On the 14th this spell of fine weather was broken. A shallow depression developed over England and caused thunderstorms and heavy rain locally at night as it moved east to the continent. Local thunderstorms also occurred in south-east England on the 18th, but were more general about the 22nd to 24th and again on the 27th.

During the latter part of the month the depressions from the Atlantic again took a more southerly course, so that unsettled conditions prevailed over the whole country with frequent high winds or gales on the coasts. On the 29th to 30th strong gales occurred also at some inland stations, while force 10 (averaging 59 miles per hour) was experienced in the Scilly Islands and at Spurn Head. Mist or fog occurred frequently in the English Channel during the earlier part of the month.

In the early days of August unclouded skies and brilliant sunshine prevailed in most parts of France. Some very high temperatures were recorded: on August 8th, 111° F. was

experienced at Toulouse: this was reported in the press as the highest reading ever recorded in France. Serious forest fires, due to the heat and dryness occurred in many places and lasted for many days. A violent gale on the 18th aggravated the fires, and on the 21st they were still raging; much damage and loss resulted. The worst fires occurred in the Midi and in the forests of Var and the Côte d'Azur. During the last week heavy rain and hail storms broke the drought at Montpelier and Beziers, vineyards were damaged and buildings struck by lightning.

The heat wave was experienced in Italy and Switzerland also, and forest fires were serious near Corbeyrier and Leysin. During the week ended the 13th violent thunderstorms and torrential rains visited many parts of Italy, and in Switzerland the storms were accompanied by a hurricane. Heavy rain storms occurred again in Italy towards the end of the month. During the early part of the month continual rains caused much damage to crops in Russia, and at Tashkent (Turkestan) violent gales destroyed crops and buildings.

Rainfall in India was normal in Upper Burma and Bengal, scanty in Hyderabad and Mysore, and excessive in Lower Burma and the Punjab. Heavy floods occurred in Burma early in the month, many people were rendered homeless, and the rice crops were almost entirely destroyed. Floods occurred on the Jumna and Ganges and lasted for a considerable time. In Bihar the floods were the highest ever recorded there. A small but intense tornado visited Moulmein (Burma) at the beginning of the month and caused great havoc.

Hong-Kong was devastated by a typhoon on the 18th and much shipping was lost; another, but less serious, typhoon occurred on the 21st.

Disastrous tidal waves swept the north-west coast of Korea at the middle of the month, causing heavy loss of life and property.

Very heavy rains again fell in South Australia; since the beginning of May rain has fallen on about five days a week, making the highest aggregate of the past 84 years.

The special message from Brazil states that rainfall was abundant in the central districts, being 37 mm. above normal, but scarce in the north and south, where it was 36 mm. and 24 mm. below normal respectively. Temperature was slightly above normal. The prospects of the coffee and sugar cane crops continue good.

Rainfall August, 1923: General Distribution

England and Wales	103	per cent. of the average 1881-1915
Scotland	159	,, ,, ,,
Ireland	149	,, ,, ,,
British Isles	128	,, ,, ,,

Rainfall Table for August, 1923

CO.	STATION.	In.	mm.	Per-cent. of Av.	CO.	STATION.	In.	mm.	Per-cent. of Av.
Lond.	Camden Square	2·01	51	91	*Leics*	Leicester Town Hall	2·09	53	...
Sur .	Reigate, Hartswood	2·14	54	...	,, .	Belvoir Castle	2·21	56	84
Kent.	Tenterden, View Tower	1·77	45	77	*Rut* .	Ridlington	2·11	54	...
,, .	Folkestone, Boro. San.	1·49	38	...	*Linc.*	Boston, Skirbeck	2·37	60	99
,, .	Broadstairs	...	..	...	,, .	Lincoln, Sessions House	2·79	71	113
,, .	Sevenoaks, Speldhurst.	2·13	54	...	,, .	Skegness, Estate Office.	2·55	65	105
Sus .	Patching Farm	2·50	63	99	,, .	Louth, Westgate	2·73	69	97
,, .	Eastbourne, Wilm. Sq.	2·24	57	90	,, .	Brigg	2·36	60	85
,, .	Tottingworth Park	2·50	63	93	*Notts.*	Worksop, Hodsock	2·29	58	93
Hants	Totland Bay, Aston	1·86	47	...	*Derby*	Mickleover, Clyde Ho.	2·56	65	94
,, .	Fordingbridge, Oaklnds	2·25	57	86	,, .	Buxton, Devon. Hos.	5·26	134	120
,, .	Portsmouth, Vic. Park.	1·88	48	84	*Ches.*	Runcorn, Weston Pt.	3·84	97	107
,, .	Ovington Rectory	2·89	73	107	,, ..	Nantwich, Dorfold Hall	3·10	79	...
,, .	Grayshott	2·93	74	105	*Lancs*	Bolton, Queen's Park .	6·04	153	...
Berks	Wellington College	2·42	61	104	,, ..	Stonyhurst College	7·66	195	151
,, .	Newbury, Greenham	2·36	60	90	,, ..	Southport, Hesketh	4·67	119	134
Herts.	Bennington House	2·12	54	88	,, ..	Lancaster, Strathspey.	5·89	150	...
Bucks	High Wycombe	2·75	70	119	*Yorks*	Sedbergh, Akay	9·01	229	161
Oxf. .	Oxford, Mag. College	3·10	79	138	,, .	Wath-upon-Dearne	2·14	54	89
Nor .	Pitsford, Sedgebrook	1·64	42	68	,, .	Bradford, Lister Pk.	3·75	95	138
,, .	Eye, Northolm	1·76	45	...	,, .	Oughtershaw Hall	...	..	...
Beds.	Woburn, Crawley Mill.	3·02	77	...	,, .	Wetherby, Ribston H.	3·42	87	125
Cam.	Cambridge, Bot. Gdns.	2·91	74	124	*ERY*	Hull, Pearson Park	2·73	69	94
Essex	Chelmsford, County Lab	2.46	63	...	,, .	Holme-on-Spalding	2·88	73	...
,, .	Lexden, Hill House	1·61	41	...	,, .	Lowthorpe, The Elms.	3·30	84	120
Suff .	Hawkedon Rectory	2·73	69	105	*NRY*	West Witton, Ivy Ho.	4·30	109	...
,, .	Haughley House	2·41	61	...	,, .	Pickering, Hungate	3·99	101	...
Norf.	Beccles, Geldeston	2·58	66	119	,, .	Middlesbrough	2·67	68	97
,, .	Norwich, Eaton	2·32	59	98	,, .	Baldersdale, Hury Res.	4·95	126	141
,, .	Blakeney	1·70	43	75	*Durh.*	Ushaw College	3·59	91	123
,, .	Swaffham	2·56	65	99	*Nor* .	Newcastle, Town Moor.	4·18	106	143
Wilts.	Devizes, Highclere	3·32	84	...	,, .	Bellingham Manor	6·05	153	..
Dor .	Evershot, Melbury Ho.	3·00	76	95	,, .	Lilburn Tower Gdns.	4·20	107	...
,, .	Weymouth, Westham	1·25	32	58	*Cumb*	Penrith, Newton Rigg.	...	..	...
,, .	Shaftesbury, Abbey Ho.	2·15	55	74	,, .	Carlisle, Scaleby Hall .	8·24	209	200
Devon	Plymouth, The Hoe	2·29	58	77	,, .	Seathwaite	21·00	533	181
,, .	Polapit Tamar	3·26	83	103	*Glam.*	Cardiff, Ely P. Stn.	4·61	117	107
,, .	Ashburton, Druid Ho.	4·20	107	112	,, .	Treherbert, Tynywaun	10·37	263	...
,, .	Cullompton	2·85	72	93	*Carm*	Carmarthen Friary	5·16	131	111
,, .	Sidmouth, Sidmount	1·80	46	64	,, .	Llanwrda, Dolaucothy.	6·00	152	109
,, .	Filleigh, Castle Hill	4·12	105	...	*Pemb*	Haverfordwest, Portf'd	...	..	...
,, .	Hartland Abbey	3·01	77	...	*Card.*	Gogerddan	3·60	91	74
Corn.	Redruth, Trewirgie	2·88	73	84	,, .	Cardigan, County Sch. .	2·90	74	...
,, .	Penzance, Morrab Gdn.	2·29	58	72	*Brec.*	Crickhowell, Talymaes	2·00	51	...
,, .	St. Austell, Trevarna	2·73	69	75	*Rad* .	Birm. W. W. Tyrmynydd	5·79	147	107
Som	Street, Hind Hayes	2·61	66	...	*Mont.*	Lake Vyrnwy	7·61	193	147
Glos. .	Clifton College	4·72	120	135	*Denb.*	Llangynhafal	3·14	80	...
,, .	Cirencester	2·30	58	75	*Mer* .	Dolgelly, Bryntirion	7·01	178	125
Here.	Ross, County Obsy.	2·14	54	83	*Carn.*	Llandudno	2·49	63	82
,, .	Ledbury, Underdown.	1·81	46	69	,, .	Snowdon, L. Llydaw 9	18·30	465	..
Salop	Church Stretton	3·11	79	96	*Ang* .	Holyhead, Salt Island.	4·47	113	141
,, .	Shifnal, Hatton Grange	2·40	61	85	,, .	Lligwy	4·14	105	...
Staff.	Tean, The Heath Ho.	3·84	97	111	*Man.*	Douglas, Boro' Cem.	6·85	174	176
Worc.	Ombersley, Holt Lock.	2·01	51	75	*Guer.*	St. Peter Port, Grange.	2·15	55	91
,, .	Blockley, Upton Wold.	2·18	55	74	*Wigt.*	Stoneykirk, Ardwell Ho	7·15	182	191
War	Farnborough	2·24	57	82	,, .	Pt. William, Monreith .	7·74	197	...
,, .	Birminghm, Edgbaston	2·50	63	92	*Kirk.*	Carsphairn, Shiel.	12·63	321	...

Rainfall Table for August, 1923—*continued*

CO.	STATION.	In.	mm.	Per-cent. of Av.	CO.	STATION.	In.	mm.	Per-cent. of Av.
Kirk.	Dumfries, Cargen	10·35	263	235	*Caith*	Loch More, Achfary	8·09	205	139
Dum	Drumlanrig	...	..	...	,,	Wick	3·60	91	131
Roxb	Branxholme	5·50	140	171	*Ork*	Pomona, Deerness	4·61	117	161
Selk.	Ettrick Manse	7·96	202	...	*Shet.*	Lerwick	4·21	107	140
Berk.	Marchmont House	4·54	115	137	*Cork.*	Caheragh Rectory	7·09	180	...
Hadd	North Berwick Res.	4·17	106	132	,,	Dunmanway Rectory	7·29	185	155
Midl	Edinburgh, Roy. Obs.	4·31	109	148	,,	Ballinacurra	5·27	134	154
Lan.	Biggar	5·76	146	173	,,	Glanmire, Lota Lo.	5·99	152	164
Ayr.	Kilmarnock, Agric. C.	7·05	179	180	*Kerry*	Valencia Obsy.	7·62	193	159
,,	Girvan, Pinmore	8·30	211	186	,,	Gearahameen	11·50	292	...
Renf.	Glasgow, Queen's Pk.	4·93	125	139	,,	Killarney Asylum	5·74	146	130
,,	Greenock, Prospect H.	7·59	193	140	,,	Darrynane Abbey	5·88	149	135
Bute.	Rothesay, Ardencraig	8·42	214	173	*Wat.*	Waterford, Brook Lo.	5·17	131	135
,,	Dougarie Lodge	6·71	170	...	*Tip.*	Nenagh, Cas. Lough	...	..	...
Arg.	Glen Etive	...	..	...	,,	Tipperary	4·99	127	...
,,	Oban	5·10	129	...	,,	Cashel, Ballinamona	5·35	136	151
,,	Poltalloch	7·01	178	143	*Lim.*	Foynes, Coolnanes	5·21	132	135
,,	Inveraray Castle	9·94	253	151	,,	Castleconnell Rec.	5·95	151	...
,,	Islay, Eallabus	6·69	170	153	*Clare*	Inagh, Mount Callan	10·65	271	...
,,	Mull, Benmore	15·60	396	...	,,	Broadford, Hurdlest'n.	6·96	177	...
,,	Mull, Quinish	...	..	...	*Wexf*	Newtownbarry	5·41	137	...
Kinr.	Loch Leven Sluice	5·17	131	135	,,	Gorey, Courtown Ho.	4·54	115	136
Perth	Loch Dhu	9·15	232	136	*Kilk.*	Kilkenny Castle	4·83	123	139
,,	Balquhidder, Stronvar.	6·86	174	113	*Wic.*	Rathnew, Clonmannon	4·75	121	...
,,	Crieff, Strathearn Hyd.	6·74	171	160	*Cars.*	Hacketstown Rectory	5·49	139	136
,,	Blair Castle Gardens	5·35	136	...	*QCo.*	Blandsfort House	5·39	137	136
,,	Coupar Angus School	4·69	119	142	,,	Mountmellick	5·62	143	...
Forf.	Dundee, E. Necropolis	4·84	123	143	*KCo.*	Birr Castle	5·37	136	141
,,	Pearsie House	6·24	159	...	*Dubl.*	Dublin, FitzWm. Sq.	4·16	106	137
,,	Montrose, Sunnyside	5·24	133	188	,,	Balbriggan, Ardgillan	5·46	139	160
Aber.	Braemar Bank	4·80	122	143	*W.M*	Athlone, Twyford	...	..	...
,,	Logie Coldstone Sch.	5·45	138	172	,,	Mullingar, Belvedere	5·74	146	138
,,	Aberdeen, Cranford Ho	5·01	127	174	*Long*	Castle Forbes Gdns.	5·82	148	142
,,	Fyvie Castle	4·05	103	...	*Gal*	Galway, Waterdale	7·05	179	...
Mor.	Gordon Castle	5·14	131	162	,,	Woodlawn	...	..	...
,,	Grantown-on-Spey	5·62	143	176	*Mayo*	Crossmolina, Enniscoe	8·07	205	179
Na	Nairn, Delnies	4·93	125	205	,,	Mallaranny	10·07	256	...
Inv.	Ben Alder Lodge	6·84	174	...	,,	Westport House	6·36	161	157
,,	Kingussie, The Birches	4·66	118	...	,,	Delphi Lodge	14·10	358	...
,,	Fort Augustus	5·23	133	151	*Sligo*	Markree Obsy.	7·40	188	171
,,	Loch Quoich, Loan	11·50	292	...	*Ferm*	Enniskillen, Portora	...	..	...
,,	Glenquoich	11·20	285	136	*Arm.*	Armagh Obsy.	4·76	119	130
,,	Inverness, Culduthel R.	4·57	116	...	*Down*	Warrenpoint	5·45	138	...
,,	Arisaig, Faire-na-Squir	6·55	166	...	,,	Seaforde	7·00	178	187
,,	Fort William	8·93	227	145	,,	Donaghadee	4·81	122	145
,,	Skye, Dunvegan	5·45	138	...	,,	Banbridge, Milltown	5·24	133	150
,,	Barra, Castlebay	3·60	91	...	*Antr.*	Belfast, Cavehill Rd.	7·14	181	...
R&C	Alness, Ardross Cas.	6·12	155	207	,,	Glenarm Castle	3·73	95	...
,,	Ullapool	5·61	142	...	,,	Ballymena, Harryville	6·21	158	145
,,	Torridon, Bendamph	7·61	193	115	*Lon*	Londonderry, Creggan	6·36	161	137
,,	L. Carron, Plockton	7·54	191	...	*Tyr*	Donaghmore	6·42	163	...
,,	Stornoway	5·32	135	134	,,	Omagh, Edenfel	6·95	177	163
Suth.	Dunrobin Castle	...	..	...	*Don*	Malin Head	6·28	159	178
,,	Lairg	5·48	139	...	,,	Letterkenny Hospital	5·70	145	127
,,	Forsinard	...	..	...	,,	Dunfanaghy	...	..	...
,,	Tongue Manse	6·87	175	215	,,	Narin, Kiltoorish	6·46	164	...
,,	Melvich School	5·68	144	191	,,	Killybegs, Rockmount	9·13	232	163

Climatological Table for the British Empire, March, 1923

STATIONS	PRESSURE: Mean of Day M.S.L. (mb.)	PRESSURE: Diff. from Normal (mb.)	TEMPERATURE: Absolute Max. (°F.)	TEMPERATURE: Absolute Min. (°F.)	TEMPERATURE: Mean Values Max. (°F.)	TEMPERATURE: Mean Values Min. (°F.)	TEMPERATURE: Mean Values ½ max. and min. (°F.)	TEMPERATURE: Mean Values Diff. from Normal (°F.)	TEMPERATURE: Mean Wet Bulb. (°F.)	Relative Humidity (%)	Mean Cloud Am'nt (0–10)	PRECIPITATION: Am'nt (mm.)	PRECIPITATION: Diff. from Normal (mm.)	PRECIPITATION: Days	BRIGHT SUNSHINE: Hours per day	BRIGHT SUNSHINE: Per-cent-age of possi-ble.
London, Kew Obsy.	1017·4	+ 4·0	68	31	50·8	38·9	44·9	+ 2·5	42·4	84	7·6	53	+ 10	14	2·3	20
Gibraltar	1017·2	+ 1·4	72	47	64·1	52·2	58·1	+ 0·6	54·5	80	5·3	38	− 84	5	...	...
Malta	1015·5	+ 1·6	66	49	59·6	51·9	55·8	− 0·3	51·4	79	5·9	23	− 11	7	5·9	50
Sierra Leone	1010·8	− 0·1	94	73	89·5	75·6	82·5	− 0·2	74·6	67	5·3	16	− 12	3	...	...
Lagos, Nigeria	1008·9	− 0·5	91	71	88·8	76·9	82·9	0·0	78·3	72	6·7	66	− 30	12	...	...
Kaduna, Nigeria	...	...	100	58	95·0	67·7	81·3	− 0·4	67·3	45	0·2	15	+ 5	2	...	...
Zomba, Nyasaland	1009·2	− 0·5	86	62	80·4	64·6	72·5	+ 1·8	...	89	7·8	266	+ 56	25	...	...
Salisbury, Rhodesia	1009·1	− 2·3	81	52	78·2	58·8	68·5	+ 0·4	63·2	78	6·2	291	+184	22	...	...
Cape Town	1014·6	+ 0·1	96	49	79·9	59·5	69·7	+ 1·5	64·8	69	2·5	18	− 6	4	...	...
Johannesburg	1012·9	− 0·1	81	49	76·0	55·0	65·5	+ 2·2	57·2	73	3·7	52	− 55	11	8·5	70
Mauritius	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Bloemfontein	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Calcutta, Alipore Obsy.	1012·2	+ 2·3	97	57	90·3	67·8	79·1	− 1·0	69·1	81	2·2	29	− 3	*1	...	...
Bombay	1011·4	+ 0·7	96	71	88·0	75·0	81·5	+ 2·0	72·8	74	2·0	0	− 1	*0	...	...
Madras	1012·2	+ 1·3	92	69	88·5	73·3	80·9	− 0·1	75·7	77	2·8	16	+ 11	*1	...	...
Colombo, Ceylon	1010·9	+ 0·9	93	70	89·4	72·9	81·1	− 0·9	77·2	64	4·6	83	− 29	13	9·0	74
Hong Kong	1017·4	+ 1·6	82	55	70·3	61·5	65·9	+ 2·6	61·2	78	6·1	17	− 59	7	5·8	48
Sandakan	...	...	89	73	86·0	75·1	80·5	− 0·6	76·0	78	...	186	− 20	14	...	...
Sydney	1015·5	− 0·7	100	69	79·8	64·5	72·1	+ 2·9	65·4	67	5·2	48	− 82	10	6·6	54
Melbourne	1016·9	− 0·1	93	45	73·6	53·8	63·7	− 0·8	57·6	60	4·8	8	− 49	4	6·3	51
Adelaide	1017·6	+ 0·6	93	50	81·7	56·9	69·3	− 0·6	58·6	47	3·2	1	− 25	1	8·6	70
Perth, W. Australia	1014·4	− 1·0	99	52	84·3	63·3	73·8	+ 2·9	63·6	54	3·3	54	+ 36	4	8·5	70
Coolgardie	1014·3	− 0·5	101	51	88·5	61·7	75·1	+ 3·4	65·1	42	4·2	13	− 6	3	...	...
Brisbane	1014·4	+ 0·3	92	62	84·8	67·2	76·0	+ 1·6	70·6	67	4·6	59	− 91	10	8·1	66
Hobart, Tasmania	1012·5	− 1·5	82	44	66·0	49·9	57·9	− 1·5	52·0	62	5·8	81	+ 38	15	6·6	53
Wellington, N.Z.	1015·3	− 1·7	70	42	65·9	53·4	59·7	− 1·0	54·3	70	6·2	51	− 32	8	5·6	45
Suva, Fiji	1005·9	− 2·6	88	71	83·8	75·1	79·5	− 0·6	77·3	89	7·4	351	− 22	28	...	...
Kingston, Jamaica	1015·3	+ 0·3	92	63	87·3	68·6	77·9	+ 0·8	...	67	3·7	16	− 10	5	...	...
Grenada, W.I.	1015·0	+ 2·1	86	69	83·0	71·4	77·2	− 0·5	70·9	69	4·3	40	− 30	17	...	...
Toronto	1016·2	− 0·8	51	3	35·6	18·6	27·1	− 1·8	22·9	53	5·5	79	+ 12	17	...	...
Winnipeg	1019·7	+ 0·9	45	−27	18·4	−5·3	6·5	− 7·9	3·5	...	3·7	33	+ 6	14	...	...
St. John, N.B.	1012·5	− 1·7	44	− 9	28·9	12·9	20·9	− 7·5	18·8	61	5·7	125	+ 10	16	...	...
Victoria, B.C.	1021·5	+ 5·7	65	31	49·0	37·9	43·5	+ 0·3	40·1	80	5·3	71	+ 6	14	...	...

* For Indian stations a rain day is a day on which 0·1 in. (2·5 mm.) or more rain has fallen.

Victoria, B.C.	1021·5	+ 5·7	65	31	49·0	37·9	43·5	+ 0·3	40·1	80	5·3	71	+ 6	14	...	...

* For Indian stations a rain day is a day on which 0·1 in. (2·5 mm.) or more rain has fallen.